Factory optimization using deep reinforcement learning AI

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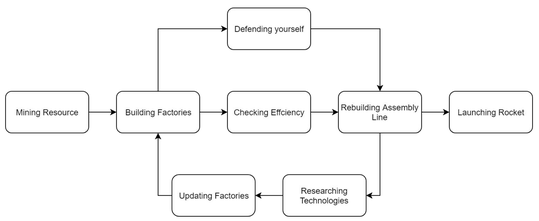
Vertically Integrated Projects

Abstract

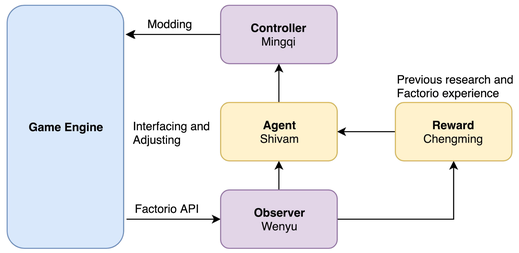
The goal of our deep reinforcement learning agent is to automate production, find creative solutions to maximize production efficiency in the Factorio game, and transfer this learning to the design and management of real-world factories.

Introduction



The research field of factory optimization aims to maximize the efficiency of the assembly line by finding optimal machine and conveyor belt placement. We are developing a reinforcement learning agent to play Factorio, a game where you build and maintain factories, without prior domain knowledge.

Methodology



Factorio is the perfect environment for deep reinforcement learning as it supports extensive modification using an in-game debugging mode which allows our agent to interface with the game effortlessly. The reinforcement learning agent implements a policy of actions based on the reward function, iteratively optimizing towards goals specified by the user. A model-free Deep Q-network agent is used in conjunction with experience replay to learn the best policy (mapping from environment state to action) by sampling past experiences. The environment state is obtained by displaying important variables in a defined location and using OCR to read the values. The DQN agent then uses the best current policy to generate a set of actions, evaluate them using the reward function, and execute the best action.

Result

The Deep Reinforcement Learning Artificial Intelligence Agent reads environment state by using OCR to decode important in-game variables being updated in real time. It then uses an MCTS-based neural network and a hand-crafted reward function to decide the best action and control the on-screen to execute that action. The best policy is decided and continuously updated by a Deep Q-Learning Agent. Various Deep Learning algorithms and agent designs are explored and compared - DQN, Double DQN, MCTS, combine value+policy network, varying degrees of exploration, etc. The Deep Reinforcement Learning Agent is expected to outperform humans in factory design, optimization, and resource management.

Conclusion

Deep Reinforcement Learning AI can build and test millions of different factory designs and production techniques which is not possible in the real world. The DRL agent then selects the best design based on user-defined constraints. Generating and testing millions of design philosophies and management techniques allows it to come up with factory designs that are more efficient than current factories, production techniques that speed up the current rate of production, and a management style highly optimized for maximum efficiency. These attributes allows low-cost, high-speed, high-reliability manufacturing which will reduce the cost of manufactured goods while maximizing profits.

Acknowledgements

We thank Professor Guang Lin for general guidance and for giving access to computational resources, Lusine Kamikyan for agent design references, Sutton & Barto for free online DRL book and David Silver for online DRL learning resources.